LONG-TERM MONITORING OF TIGER SALAMANDERS, AMBYSTOMA TIGRINUM, IN THE BOULDER FOOTHILLS

ABSTRACT

For the second year in a three year study, four ponds in the Boulder foothills were sampled to contribute to a long term monitoring of the populations of the tiger salamander, Ambystoma tigrinum. Ponds were sampled with a hand held seine on 7 days. A total of 1476 captures were made, mainly from the Pollywog and Shanahan ponds. Of those captures, 125 were recaptures from the 179 marked in 1995, and 206 were newly marked individuals for 1996. After three years of data have been collected, an estimate of populations sizes for each tracked population will be made to assess any changes in the abundance of salamanders at these ponds.

OBJECTIVE AND HYPOTHESES

The overall objective of the work is to assess the long term health of populations of the tiger salamander, Ambystoma tigrinum, in the Boulder foothills, specifically the ponds on Shanahan Hill in the Boulder Open Space. The work will provide insight into the long-term health of the habitat, because some animals have already been marked and baseline population data from 1974-1975 (Rodda, 1975a; 1975b; 1986) are available for replication and reevaluation. Although there are no immediate plans to use the data for tests of large scale habitat alterations (e.g., introduction of exotic species such as bluegills, Lepomis macrochirus; discontinuation of grazing; deposition of air pollutants in vulnerable surface waters), these data will provide long-term assessments that might contribute to such tests. Larson and Fivizanni (1994) proposed that tiger salamanders be used as indicators of environmental stress. Population data collected by this study could then contribute to evaluation of stress responses.

The primary null hypothesis to be tested is that there has been no change in the abundances of the salamanders at the three ponds previously sampled. Secondary null hypotheses are that there have been no inter-pond movements of marked individuals among the three ponds. The secondary null hypotheses are not likely to be rigorously tested, as it is probable that most of the marked individuals have died in the intervening 20-21 years. However, it is possible that some of the marked individuals survive, as the tags are permanent, some have been recovered by other researchers in the last decade (David Norris, pers. comm.), and the proven longevity of neotenic tiger salamanders is in excess of 25 years (Nigrelli, 1954), adult morphs are known to survive for more than 20 years (Slavens and Slavens, 1992), and an adult of a closely related species, A. maculatum, has lived to 29 years (Koch, 1952). Thus there is a possibility that some of the approximately 180 individual salamanders marked in the Shanahan Hill ponds in 1974-1975 might be recaptured, providing longevity information for this area.

Scientific progress will be aided by making available basic demography facts on a species that has attracted some attention in environmental health studies (e.g., Harte and Hoffman, 1989; Pechmann and Wilbur, 1994). Public education might be enhanced if records demonstrate that an inconspicuous salamander achieves life spans of more than 20 years in small ponds in the Boulder Open Space.

This work will contribute to the herpetological inventory requested for Boulder Open Space. To the extent that basic inventory data informs scientists with regard to large scale environmental changes such as species introductions, or the effects of livestock grazing (Heyer et al., 1994), this study will contribute to the identification of appropriate management policies for the Open Space.

METHODOLOGY

The ponds, located at an elevation of about 1765 m near 39°59'35" N, 105°15'43" W in section 18 of the South Mesa Trail area were sampled with a hand held seine on 7 days (Table 1). Captives were temporarily held in plastic buckets while we collected basic morphological measurements (SVL, total length, tail height, sex, and mass) (Table 2). Unmarked individuals were permanently marked with tiny monel metal jaw tags (National Band and Tag, Co.), and all individuals were released at their point of original capture after completion of measuring and tagging at each pond. Additional field methods followed those of Rodda (1975a).

RESULTS AND CONCLUSIONS

Of the 179 individuals marked in 1995, 125 were captured in 1996, and an additional 206 new individuals were marked in 1996. The greatest number of salamanders were caught in Shanahan Pond, 933 captures of 265 tagged neotenes and 1 terrestrial morph. Substantial numbers of individuals (540 captures of 68 tagged neotenes and 2 terrestrials) were caught in Pollywog Pond. Similar to last year's sampling, few salamanders were found in Abbey Pond (1 terrestrial morph) and Salamander Pond (0). Abbey Pond has had a dramatic change in population density; previous population studies indicated this pond had the densest population (more than 300) of the four ponds(Rodda 1975a, 1975b).

A possible cause for the decline in salamanders in Abbey pond may be the establishment of a population of crayfish believed to be the non-native Orconectes virilis. Crayfish are omnivorous predators which are known to feed on the eggs and larvae of salamanders and frogs. The disappearance of the population that was the primary subject of the 1974 sampling makes it unlikely that any individuals marked in that earlier study are still alive. There is a remote possibility that some of the previously-marked terrestrial morphs will eventually be found. Two of the aforementioned ponds, Pollywog and Salamander contained large numbers of

Pseudacris tadpoles and/or froglets, and Pollywog also contained large numbers of Dytiscid insects.

Table 1. Number of neotenic (N) and terrestrial (T) Ambystoma tigrinum captures at four ponds on Shanahan Hill in 1996 (np indicates no seine pulls).

	Pollywog		**Abbey**		**Salamander**		**Shanahan**	
Date	N	T	N	T	N	T	N	T
7 June	124	0	0	1	0	0	94	0
26 June	124	0	0	0	np	np	112	0
5 July	183	0	0	0	np	np	85	1
3 Oct	53	1	np	np	np	np	np	np
4 Oct	19	0	0	0	np	np	95	0
9 Oct	37	1	np	np	np	np	335	0
16 Oct	np	np	np	np	np	np	212	0
Total	540	2	0	1	0	0	933	1

Table 2. Mean snout-vent length (SVL), total length (TL), and head width (HW) of male (M), female (F), and juvenile (J) salamanders caught at Pollywog, Abbey, and Shanahan ponds in 1996.

	Pollywog			**Abbey**			**Shanahan**		
Size	M	F	J	M	F	J	M	F	J
SVL	74	92.8	52.4	104	na	na	100.9	94.9	76.9
TL	131	170.5	144.7	198	na	na	187.3	174.4	143.3
HW	18	29.5	22.8	23	na	na	27.4	27.0	21.4

Because they must be successful in both terrestrial and aquatic environments, amphibians are uniquely sensitive to precipitation and water levels. As a result of weather fluctuations, wide annual variation in amphibian numbers is normal (Heyer et al., 1994). Therefore, estimates of population sizes need to be evaluated over several years, to reduce short-term population "noise." This study will incorporate three years of data, after which the densities of each tracked

population will be carefully analyzed for long term trends and their interpretation.

LITERATURE CITED

HARTE, J., AND E. HOFFMAN. 1989. Possible effects of acidic deposition on a Rocky Mountain population of the tiger salamander Ambystoma tigrinum. Conserv. Biol. 3:149-158.

HEYER, W. R., M. A. DONNELLY, R. W. MCDIARMID, AND L. A. HAYAK. 1994. Measuring and monitoring biological diversity: standard methods for amphibians. Smithsonian Inst. Press, Washington, DC.

KOCH, C. 1952. Von mainen ältesten Urodelen. Aquar. Terrar. Z. Stuttgart 5:18-19.

LARSON, D. L., AND A. J. FIVIZZANI. 1994. Hormonal response to acute stress as a biomarker for chronic stress in larval Ambystoma tigrinum. N. Dakota Acad. Sci. Proc. 48:18 (abstr.).

NIGRELLI, R. F. 1954. Some longevity records of vertebrates. Trans. New York Acad. Sci. 16:296-299.

OTIS, D. L., K. P. BURNHAM, G. C. WHITE, AND D. R. ANDERSON. 1978. Statistical inference from capture data on closed animal populations. Wildl. Monogr. (62):1-135.

PECHMANN, J. H. K., AND H. M. WILBUR. 1994. Putting declining amphibian populations in perspective: natural fluctuations and human impacts. Herpetologica 50:65-84.

RODDA, G. H. 1975a. Population structure of neotenic Tiger Salamanders, Ambystoma tigrinum, from a foothills pond near Boulder, Colorado. J. Colo.-Wyo. Acad. Sci. 7:32 (abstr.).

------. 1975b. The life history of the Tiger Salamander, Ambystoma tigrinum, from three foothills ponds near Boulder, Colorado. J. Colo.-Wyo. Acad. Sci. 7:32 (abstr.).

------. 1986. A comparison of locomotor activity in neotenic and terrestrial salamanders (Ambystoma tigrinum). Herpetologica 42:483-491.

SLAVENS, F. L., AND K. SLAVENS. 1992. Reptiles and amphibians in captivity: breeding - longevity and inventory current January 1, 1992. Woodland Park Zoological Gardens, Seattle. 497 pp.